ABSTRACT OF THE DISCLOSURE

An electrically regeneratable battery of electrochemical cells for capacitive deionization (including electrochemical purification) and regeneration of electrodes is operated at alternate polarities during consecutive cycles. In other words, after each regeneration step operated at a given polarity in a deionization-regeneration cycle, the polarity of the deionization step in the next cycle is maintained. In one embodiment, two end electrodes are arranged one at each end of the battery, adjacent to end plates. An insulator layer is interposed between each end plate and the adjacent end electrode. Each end electrode includes a single sheet of conductive material having a high specific surface area and sorption capacity, preferably a sheet formed of carbon aerogel composite. The battery further includes a plurality of generally identical double-sided intermediate electrodes that are equidistally separated from each other, between the two end electrodes. As the electrolyte enters the battery of cells, it flows through a continuous open serpentine channel defined by the electrodes, substantially parallel to the surfaces of the electrodes. By polarizing the cells, ions are removed from the electrolyte and are held in the electric double layers formed at the carbon aerogel surfaces of the electrodes. As the electrodes of each cell of the battery are saturated with the removed ions, the battery is regenerated electrically at a reversed polarity from that during the deionization step of the cycle, thus significantly minimizing secondary wastes.